Index Color Image Retrieval Using Error Diffusion Block Truncation Coding Features

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Abstract:This paper presents a new approach for compression and Retrieval. To index color images,features are extracted from the EDBTC it stands for Error Diffusion Block Truncation Coding. The EDBTC compression produces a bitmap image and two color quantizers, which are processed using vector quantization (VQ) to generate the image feature descriptor.Bitpattern Histogram Feature (BHF) and Color pattern Histogram Feature (CHF) are computed. The CHF is calculated from VQ-indexed color quantizer and BHF is calculated from VQ-indexed bitmap image.Based on these features, similarity is measuredbetween a query image and database images. Finally, image retrieval system returns a set of images to the user as output with a specific similarity criterion, such as texture and color similarities.Thus, proposed method EDBTC is examined with good capability for image compression and also it offers an effective way to index images for the image retrieval.

Keywords: vector quantization, image retrieval, Error Diffusion Block Truncation Coding(EDBTC)

I.INTRODUCTION

Many schemes have been developed to improve the accuracy of retrieval in the Content Based Image Retrieval (CBIR) system[5][7].The existing system is BTC[2] it stands for Block Truncation Coding .In BTC compression an image is divided into multiple non overlapped image blocks, and each block is represented with a bitmap image and with two quantizers they are low and high mean values .Two subimages constructed by the two quantizers and the corresponding bitmap image are produced at the end of the BTC encoding stage, which are later transmitted into the decoder module through the transmitter.To generate the bitmap image, the BTC performs thresholding operation by using the mean value of each image block such that a pixel value greater than the mean value is regarded as 1 (white pixel) and vice versa.The drawbacks in the existing system is BTC method does not improve the compression ratio compared with JPEG or JPEG 2000. It also suffers from blocking effect and false contour problems. Because of these problems it makes less satisfactory for human perception.

To overcome the disadvantages of existing method.In this retrieval scheme EDBTC[3][4] compression is employed and image features are extracted from the compressed data[1]. As different from classical approach, in this retrieval method image descriptor is extracted from the compressed data without performing the decoding . This type of retrieval looks for the reduction of time computation for feature extraction.Since almost all of the multimedia images are already converted into compression mode before recording to any storage devices. This image retrieval scheme has two phases they are indexing and searching. The image features are extracted in the indexing phase from all of the images in the database and stored. In the searching phase, the retrieval system derives the image features from the query image, which are later used for performing similarity matching on the feature vectors stored in the database.

II.PROPOSED SYSTEM

2.1.Error Diffusion Block Truncation Coding (EDBTC)

The proposed system is Error Diffusion Block Truncation Coding.In this method input image is compressed using EDBTC.The output of EDBTC compression is two quantizers i.e, maximum quantizer and maximum quantizer and a bitmap image.The disadvantages of existing system BTC can be overcome with Error Diffusion BTC (EDBTC).EDBTC solved the blocking effect and false counter problems.Image compression ratio is improved. Fig1 shows the schematic diagram of the proposed image retrieval framework.

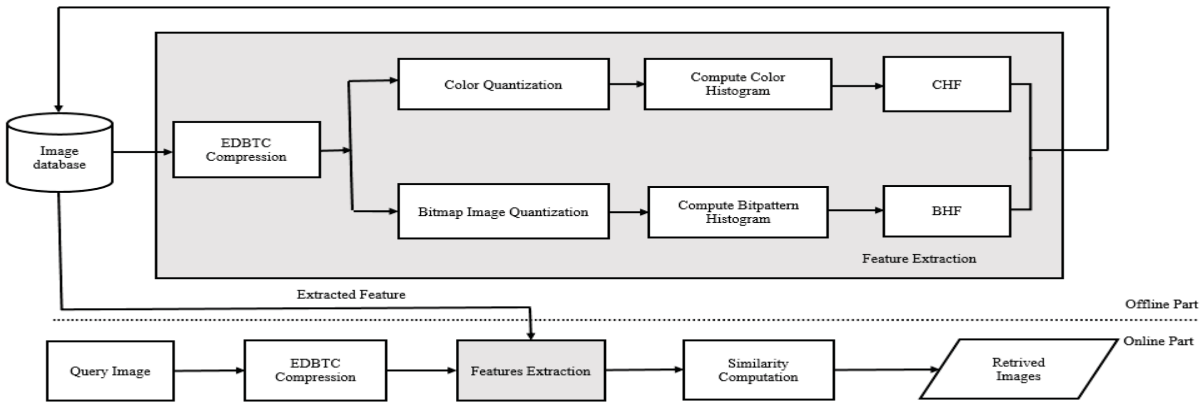


Fig 1: Schematic diagram of the proposed image retrieval framework

2.2.EDBTC FOR COLOR IMAGES

The EDBTC compresses image in an effective way by employing the error diffusion kernel for the generation of a bitmap image. At the same time, it produces two extreme quantizers, namely maximum and minimum quantizers. The EDBTC offers low computational complexity in the two extreme quantizers and a bitmap image generation. Compared with the classical BTC, EDBTC produces better image quality.Both EDBTC and BTC schemesproducebitmap image and the two extreme quantizersat the end of the compression stage.

Suppose a color image of size M × N is divided into nonoverlapped image blocks of size m × n. Let f (x, y) = {f_R(x, y), f_G(x, y), f_B(x, y)} be an image block, where y = 1, 2, . . . ,m and x = 1, 2, . . . , n. Suppose that f (x, y) denotes the original image and $\bar{f}$(x, y) denotes the interband average value.The interband average value$\bar{f}$(x, y) can be calculated as

$$\bar{f}(x,y) = \frac{1}{3}\left(\left(f_R(x,y) + f_G(x,y) + f_B(x,y)\right)\right)$$

The f_R(x, y) is image pixels in red channel,f_G(x, y) is the image pixels in green channel and f_B(x, y) is the image pixels in blue channel. The outputof inter-band average image can be viewed as the grayscale version of the image.

The EDBTC performs the thresholding operation by employing the error kernel. The maximum, minimum and mean values of the inter-band average pixels are calculated as

$$x_{min} = \min_{\forall x,y} \bar{f}(x,y)$$

$$x_{max} = \max_{\forall x,y} \bar{f}(x,y)$$

$$\bar{x} = \sum_{x=1}^{m}\sum_{y=1}^{n} \bar{f}(x,y)$$

The h(x, y) is thebitmap image is generated using the following rule

$$h(x,y) = \begin{cases} 1, \text{if } \bar{f}(x,y) \geq \bar{x} \\ 0, \text{if } \bar{f}(x,y) < \bar{x} \end{cases}$$

The o(x, y) is the intermediate value is alsosimultaneously generated at the same time with the bitmap image generation. The intermediate value o(x, y) can be calculated as

$$o(x,y) = \begin{cases} x_{max}, & if\ h(x,y) = 1 \\ x_{min}, & if\ h(x,y) = 0 \end{cases}$$ The e(x,y)is the residual quantization error of EDBTC can be calculated as

$$e(x,y) = \bar{f}(x,y) - o(x,y)$$

In a consecutive way EDBTC thresholding process is performed. One pixel is only processed once, and the residual quantization error is diffused and accumulated into the neighboring unprocessed pixels. The value f¯(x, y) of unprocessed, yet pixel is updated using the following strategy

$$\bar{f}(x,y) = \bar{f}(x,y) + e(x,y) * \epsilon$$

Where'ϵ' is the error kernel to diffuse the quantization residual into its neighboring pixels which have not yet been processed in the EDBTC thresholding. The symbol ∗ denotes the convolution operation. Several error kernels can be used to perform the diffusion operation, such as Jarvis error kernel , Burkers[6], Floyd–Steinberg , Sierra[6], Stucki[8] , and Stevenson[9].

The two extreme quantizers consist of RGB color information .Two EDBTC color quantizers are computed form the minimum and maximum of all image pixels in each image block as

$$q_{min}(i,j) = \left\{ \min_{\forall x,y} f_R(x,y), \min_{\forall x,y} f_G(x,y), \min_{\forall x,y} f_B(x,y) \right\}$$

$$q_{max}(i,j) = \left\{ \max_{\forall x,y} f_R(x,y), \max_{\forall x,y} f_G(x,y), \max_{\forall x,y} f_B(x,y) \right\}$$

Figure 2 shows the schematic diagram of the Error Diffusion Block Truncation Coding. At the end of the EDBTC compression process, two color quantizers and a bitmap image sent to the decoder via a transmission channel. The decoder simply replaces the bitmap image which has value 1 with the maximum quantizer, while the value 0 is substituted with the minimum quantizer. Compared with the BTC scheme, the EDBTC overcomes the blocking effect and false contour artifacts producing in the EDBTC image reconstructed.

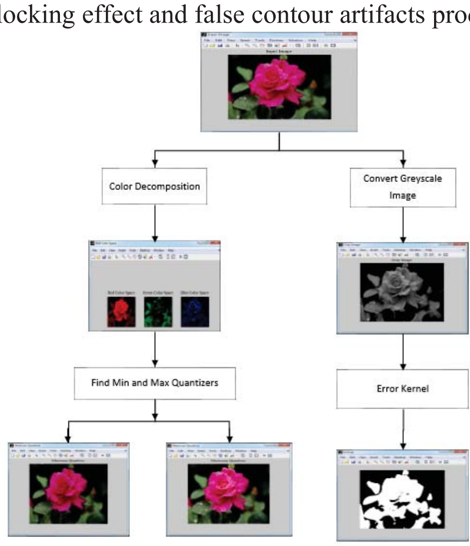


Fig. 2. Schematic diagram of EDBTC compression for color image.

A. Vector Quantization

VQ compresses an image in lossy mode based on block coding principle. It is a fixed-to-fixed length algorithm .Based on block coding principle, VQ compresses an image in lossy mode. The VQ finds a codebook by dividing a given source vector with its known statistical properties to produce the code vectors with the smallest average distortion.

Let $C = \{c1, c2,. . . ,cNc\}$ be the color codebook which consists Nc codewords generated using VQ . The VQ needs many images involved as the training set. The vector ck contains RGB color information which is identical to the two quantizers. For the color codebook generation, it is required to construct For generation of the bit patterncodebook, bitmap images are in trainingset in the VQ process.Using the soft centroid principle[10],hard binarization is performed to all code words

Let $C = \{c1, c2, . . . ,cNc\}$ be the color codebook, the VQ indexes the EDBTC maximum and minimum quantizers using the symbols *j* and idenote the index of image block.

$$\tilde{\imath}_{min}(i,j) = \quad arg \min_{k=1,2,\dots,N_c} \left\| q_{min}(i,j), c_k^{min} \right\|_2^2$$

$$\tilde{\imath}_{max}(i,j) = \quad arg \max_{k=1,2,\dots,N_c} \left\| q_{max}(i,j), c_k^{max} \right\|_2^2$$

for all i=1,2,….$\frac{M}{m}$ and j=1,2,…..$\frac{N}{n}$

The bit pattern codebook $B = \{B1, B2, . . ,BNb\}$ consisting of *Nb* binary codewords. VQ indexes the EDBTC bitmap image based on the bit pattern codebook

$$\tilde{b}(i,j) = \text{argmin}_{k=1,2,\dots,Nb}\, \delta_H \{b_m(i,j), B_k\}$$

for all i=1,2,….M/m and j=1,2….N/n.

The symbol δ_H denotes hamming distance between two binary pattern.

The VQ performs indexing for both bitmap image and color images which may reduce the bit required in the EDBTC compression scheme.Thus VQ information not only useful for image compression but also useful for image indexing during image retrieval.

B.Color Histogram Feature

The CHF is derived from the two EDBTC color quantizers, while BHF is computed from EDBTC bitmap image. In this paper, the CHF_{min} and CHF_{max} are developed from the color minimum and maximum quantizers, respectively. The CHF_{min} and CHF_{max} capture color information from a given image. These features represent the combination of pixel brightness and color distribution in an image. The CHF_{min} and CHF_{max} features can be computed using

$$CHF_{min}(k) = P_r \left\{ \tilde{\imath}_{min}(i,j) = k \middle| i = 1,2,\dots,\frac{M}{m}; j = 1,2,\dots,\frac{N}{n} \right\}$$

$$CHF_{max}(k) = P_r \left\{ \tilde{\imath}_{max}(i,j) = k \middle| i = 1,2,\dots\dots\frac{M}{m}; j = 1,2,\dots,\frac{N}{n} \right\}$$

The color quantizers are Vector Quantized(VQ). Vector Quantizer calculates certain color codewords occurence in an image. Fig. 3 shows the CHF computation of the proposed EDBTC image retrieval system.

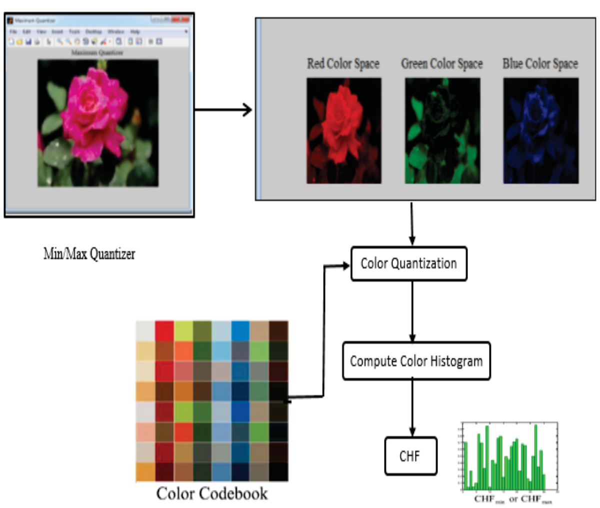


Fig. 3. Illustration of CHF computation.

C.Bit Pattern Histogram Feature (BHF)

Fig. 4 shows the flowchart of the BHF computation. The BHF appeared as the histogram of the indexed bit pattern of the bitmap imageBitpattern Histogram Feature(BHF) is another feature calculated from the VQ-indexed data stream. BHF captures the textual, edge and visual pattern information in an image. The appearance of a specific bit pattern codebook in an image is used to generate the BHF. The BHF using

$$BHF(k) = P_r\left\{\bar{b}(i,j) = k \,\middle|\, i = 1,2,\ldots,\frac{M}{m}; j = 1,2,\ldots,\frac{N}{n}\right\}$$

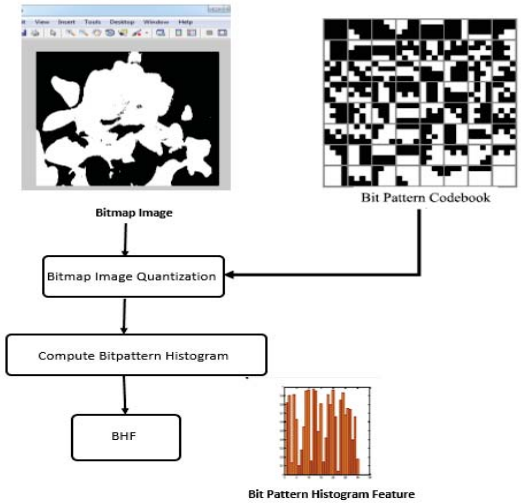


Fig. 4. Illustration of BHF computation

D.Image Retrieval With EDBTC Feature

Tomeasure the similarity between the query and the target images distance is computed.The distance plays the most important role in the retrieval system.Since the retrieval result is very sensitive by the chosen distance metric. The image matching is performed by calculating the distance between the query(input image) image given by an user against the target images in the database based on their corresponding features (CHF and BHF). After measuring the similarity distance the system returns a set of retrieved image in ascending manner based on their similarity distance values.The similarity distance between the two images, i.e, target and query images can be computed as

$$\delta(query, target) = \alpha 1 \sum_{k=1}^{N_C} \frac{\left|CHF_{min}^{query}(k) - CHF_{min}^{target}(k)\right|}{CHF_{min}^{query}(k) + CHF_{min}^{target}(k) + \varepsilon} + \alpha 2 \sum_{k=1}^{N_C} \frac{\left|CHF_{max}^{query}(k) - CHF_{max}^{target}(k)\right|}{CHF_{max}^{query}(k) + CHF_{max}^{target}(k) + \varepsilon} + \alpha 3 \sum_{k=1}^{Nb} \frac{\left|BHF^{query}(k) - BHF^{target}(k)\right|}{BHF^{query}(k) + BHF^{target}(k) + \varepsilon}$$

where $\alpha 1$, $\alpha 2$, and $\alpha 3$ are the similarity weighting constants representing the percentage contribution of the CHF andBHF in the proposed image retrieval process. The value 1means that the color or bit pattern feature is catered in the similarity distance, while the value 0 meaning that the color or bit pattern feature is disabled in the distance computation.A small number ε is added into denominator to avoid the mathematic division error. The CHF_{query} and BHF_{query} denote the color and bit pattern feature descriptors of the query image, respectively, while the symbols CHF_{target} and BHF_{target} represent the image descriptors of the target image in database.

E.Performance Measurement

The successfulness of the proposed EDBTC retrieval system is measured with the precision, recall, and average retrieval rate (ARR) values. These values indicate the percentage of relevant image returned by a CBIR system with a specific number of retrieved images *L*. The precision (*P(q)*) and recall (*R(q)*) values are defined as

The precision value (P(q)) is defined as

$$P(q)=\frac{n_q}{L}$$

The recall value (R(q)) is defined as

$$R(q)=\frac{n_q}{N_q}$$

Where, n_q denotes the number of relevant images against a query image q and Nq represents all relevant images against a query image q in the database.

The other metric used to measure the retrieval performance is ARR value ,ARR can be defined as

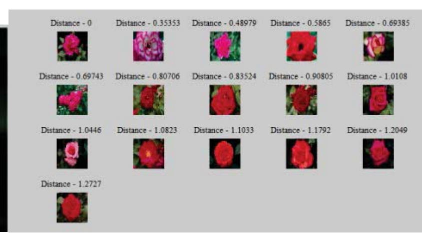
$$ARR=\frac{1}{|DB|}\sum_{i=1}^{|DB|} R(I_i,n)]_{n\geq 16}$$

$$R(I_i,n)=\frac{n_q}{N_q}$$

Where the |DB| denotes the total number of images in the database.A higher value in recall and precision exhibits the better retrieval results.

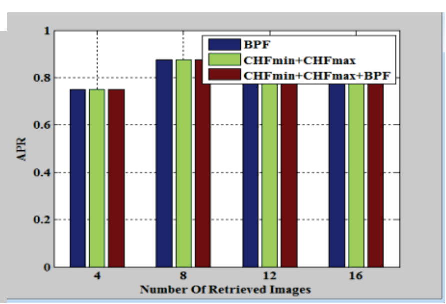
III.EXPERIMENTAL RESULTS

In this area, experimental results are reported to demonstrate the effectiveness of the proposed EDBTC image indexing method. To have an in depth investigation of the successfulness of the proposed Image Retrieval system, imagedatabases consist of several images of the natural and textural images are utilized in this experiment. Using the proposed CHF and BHF EDBTC featuresproposed image retrieval system extracts the image features from all images in the database.Based on the distance similarity score from their descriptors the similarity between the query and target images is measured. A set of retrieved images is returned as the output by the system in ascending order based on the distance values. In this experiment, the retrieval accuracy is measured using the ARR or average recall, average precision value over all query images. The higher average precision rate and ARR value indicate that the system is able to retrieve a set of returned image which has more similar appearance with the query image.

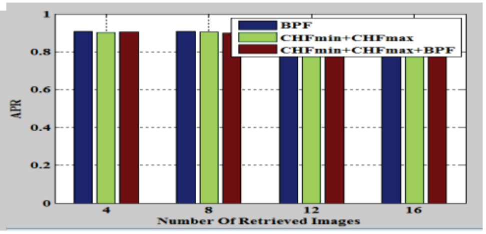
(a)(b)

	BPF	CHFmin+CHFmax	CHFmin+CHFmax+BPF
4	0.7500	0.7500	0.7500
8	0.8750	0.8750	0.8750
12	0.8333	0.8333	0.8333
16	0.8750	0.8750	0.8750

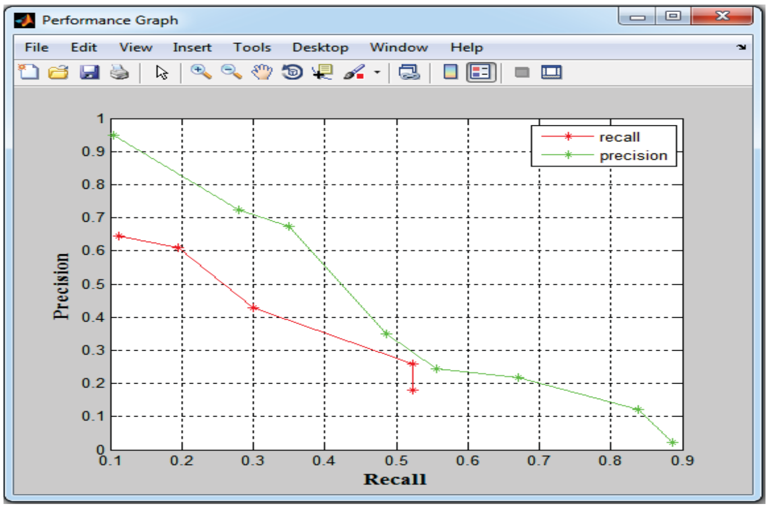


(c) (d)

	BPF	CHFmin+CHFmax	CHFmin+CHFmax+BPF
4	0.9083	0.9014	0.9050
8	0.9083	0.9060	0.9006
12	0.9027	0.9077	0.9009
16	0.9053	0.9040	0.9091



(e) (f)



(g)

FIG:5 (a). Input Image (b).Retrieval Images (c).Average Precision Rate(APR) (d)Performance Graph For APR (e).Average Recall Rate (f).Performance Graph For ARR (g).Performance Graph For Presicion and Recall

IV.CONCLUSION

New method is proposed in this paper for color image indexing by exploiting the simplicity of the EDBTC method. From color images a feature descriptor is constructed from the EDBTC encoded data (two representative quantizers and its bitmap image) by Vector Quantizer(VQ). The BHF characterizes the image edge and texture while the CHF effectively represents the color distribution within an image.The results demonstrate that the proposed method is not only superior to the former existing methods in the literature related to the CBIR but also to the former BTC-based image indexing schemes . To achieve a higher retrieval accuracy, another feature can be added into the EDBTC indexing scheme with the other color spaces, such as hue–saturation–intensity, YCbCr and lab. An extension of the EDBTC image retrieval system can be brought to indexvideo by considering the video as a sequence of images. This strategy shall consider the temporal information of the video sequence to meet the user requirement in the CBIR context.

REFERENCES

[1] G. Qiu, "Color image indexing using BTC," *IEEE Trans. Image Process.*,vol. 12, no. 1, pp. 93–101, Jan. 2003.

[2] X. Wang and Z. Wang, "The method for image retrieval based on multifactors correlation utilizing block truncation coding," *Pattern Recognit.*, vol. 47, no. 10, pp. 3293–3303, 2014

[3] J.-M. Guo and Y.-F. Liu, "Joint compression/watermarking scheme using majority-parity guidance and halftoning-based block truncation coding," *IEEE Trans. Image Process.*, vol. 19, no. 8, pp. 2056–2069, Aug. 2010.

[4] J.-M. Guo, "Improved block truncation coding using modified error diffusion," *Electron. Lett.*, vol. 44, no. 7, Mar. 2008, pp. 462–464.

[5] P. Poursistani, H. Nezamabadi-Pour, R. A. Moghadam, and M. Saeed, "Image indexing and retrieval in JPEG compressed domain based on vector quantization," *Math. Comput. Model.*, vol. 57, nos. 5–6, pp. 1005–1017, 2013

[6] D. L. Lau and G. R. Arce, *Modern Digital Halforning*, 2nd ed. CRC Press, 2008, pp. 83–89.

[7] F.-X. Yu, H. Luo, and Z.-M. Lu, "Colour image retrieval using pattern co-occurrence matrices based on BTC and VQ," *Electron. Lett.*, vol. 47, no. 2, pp. 100–101, Jan. 2011

[8] P. Stucki, "Image processing for document reproduction," in *Advances in Digital Image Processing*. New York, NY, USA: Plenum, 1979,pp. 177–218.
[9] R. L. Stevenson and G. R. Arce, "Binary display of hexagonally sampled continuous-tone images," *J. Opt. Soc. Amer. A*, vol. 2, no. 7, pp. 1009–1013, 1985.
[10] P. Franti and T. Kaukoranta, "Binary vector quantizer design using soft centroids," *Signal Process., Image Commun.*, vol. 14, no. 9, pp. 677–681,1999.